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Title :
Multilayer filtering material for cleaning of gases - has additional fibrous layer whose needle puncturing density is double that of the outer layers

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Basic Abstract :
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The material has face and reverse layers (1,2) made of synthetic fibres and an intermediate framework layer (4) made as woven or non-woven cloth of synthetic threads, and connected by needle puncturing and heat treatment. The material also has an additional fibrous layer (3) whose needle puncturing density is double that of the outer layers. The framework layer is situated in the additional layer at a distance from the outlet layers exceeding their thickness. The face and reverse layers have similar thickness and surface density.

The material is formed by forming the outer face and reverse layers with simultaneous laying of the intermediate layer and the layers connection by needle puncturing and subsequent heat treatment. The additional layer needle puncturing on the face layer side is carried out to boundary with the reverse layer, and needle puncturing on the reverse layer side is carried out to its boundary with the face layer. The heat treatment is carried out on a friction calender with linear velocity ratios of its inlet and outlet rolls of 1:(1.2-1.5).

USE/ADVANTAGE - Multilayer filtering material prodn. Material operation properties are increased. Bul.13/7.4.92 (Dwg.1/1)

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(12) ABSTRACT OF INVENTION

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(54) MULTI-LAYER FILTRATION CLOTH FOR GAS CLEANING AND ITS PRODUCTION METHOD

(57)

Изобретение относится к производству нетканых фильтровальных материалов, предназначенных преимущественно для очистки горячих промышленных и природных газов. Изобретение позволяет улучшить эксплуатационные свойства материала без увеличения его сырьеемкости за счет того, что наружные лобовой и изнаночный слои имеют одинаковую толщину и поверхностную плотность. Между ними расположен дополнительный волокнистый слой, плотность иглопрокалывания которого вдвое выше, чем у наружных слоев, а промежуточное каркасное полотно расположено в дополнительном волокнистом слое на удалении от наружных поверхностей лобового и изнаночного слоев, превышающем толщину каждого из указанных слоев. Такую структуру получают посредством прокладки промежуточного каркасного слоя в дополнительном волокнистом слое, который формируют между наружными слоями одинаковой толщины и поверхностной плотности, причем иглопрокалывание осуществляют со стороны лобового слоя на глубину, не достигающую изнаночного слоя, и со стороны изнаночного слоя на глубину, не достигающую лобового слоя, а термообработку проводят на фрикционном каландре при соотношении линейных скоростей его входного и выходного валов 1:(1,2-1,5). 2 с.п. ф-лы, 1 ил., 1 табл. со С

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MULTI-LAYER FILTRATION MATERIAL FOR GAS CLEANING AND A METHOD FOR THE MAKING THEREOF

(57) The invention relates to the production of nonwoven filter materials intended mainly for the cleaning of hot industrial and natural gases. By means of the invention the operating characteristics of the material are improved without increasing its raw material capacity due to an outer face layer and an outer reverse layer having an identical thickness and surface density, an additional fibrous layer is placed between them, the density of its needlepiercing being two times higher than of the outer layers, and a temporary framework cloth placed in the additional fibrous layer at a distance from the outer surfaces of the face layer and of the reverse layer, the thickness of the temporary framework layer exceeding each of said layers. Such a structure is obtained by means of placing a temporary framework layer in the additional fibrous layer, which is formed between the outer layers of identical thickness and surface density, the needlepiercing being performed from the side of the face layer to a depth which does not reach the reverse layer, and from the side of the reverse layer to a depth which does not reach the face layer, and heat treatment is performed on a friction calender, the correlation of the linear velocities of its inlet and outlet rolls being 1:(1,2-1,5).

The invention relates to the production of nonwoven filter materials intended mainly for the cleaning of hot industrial and natural gases. Such filter materials are used in tube form.

From earlier is known a multi-layer filter material made of fibre matting, which at the air inlet side includes a porous layer of coarse synthetic fibres and at the outlet side a dense layer of fine synthetic fibres attached to each other by fibre bundles by means of needlepiercing. To increase the effectivity of the cleaning, while maintaining a high dust holding capacity, a temporary layer in the form of an even bonded or heat fused nonwoven material is placed between the porous and the dense layer, furthermore fibre bundles of fine fibres run through the temporary layer to a depth of approximately 1/3 of the thickness of the coarse fibre layer, and fibre bundles of coarse fibres are placed in the porous layer without reaching the temporary layer.

The known filter material has a porous structure, which is confirmed by its high air permeability (494 dm3/m2c), however, at a high input air pres-

sure this can cause damage in the material. At the filtration of hot gases the possibility of using a dense bonded or heat fused nonwoven cloth as the framework is excluded, as among the hot gases a destruction of the adhesive or a softening of the termoplastic polymere securing the fibres can occur, which, in turn, leads to a decrease in the strength and a damage of the cloth. Besides that, in the process of exploitation a periodic mechanical shaking of the tubes is carried out, which at a poor fastening of the layers of the cloth one with another also can lead to damage in the material.

There is also known a filter material for the cleaning of hot gases, which is comprised of outer layers of fibre material, consisting of a face layer, a closing layer and a temporary layer, connected one to the other. To increase the operating characteristics the outer layers of the material are realized of mixtures of shrinked and unshrinked transversely orientated polyester fibres, and the temporary layer – the thread sewn nonwoven cloth – of complex polyester threads, in which case the relation between the surface density and the thickness of the outer face layer and that of the closing outer layer is 1,5:1-3:1.

To obtain this material the fibre matting is made preferably with a transverse orientation of the fibres of a mixture of copolyester and polyester fibres, between the fibre matting layers a framework in the form of a thread sewn cloth of complex threads is placed, needle piercing is carried out, followed by heat treatment of the cloth in a hot air environment. Sintering of the face surface of the material is possible.

The disadvantage of the known material and method of manufacturing it consists in the fact that through-openings are made in the outer face, temporary and closing layers by the mechanical operation of the needles, which openings under the operation of the following heat treatment, although decreasing in size, remain in the material, making the penetration of particles (especially fine-grained, in the order of 1-10 micromillimetres) possible through these openings. The pollutant particles that have penetrated the structure of the cloth meet the main obstacle at the border of the face layer and the framework layer, as the structure of the cloth is more compressed at this place. Here the probability of a gathering of these particles arises, which is why the pressure on the filter material, being high even without that, sharply rises. The structure of the filter material is not able to withstand a high pressure (4000-6000 Pa) and is damaged and the filtering property of the material decreases sharply.

The aim of the invention is to improve the operating characteristics of the material without increasing its raw material capacity.

The essence of the invention is comprised in that in the nonwoven material, containg a face and a reverse outer fibrous layer of synthetic fibre, and a temporary layer in the form of woven or a nonwoven cloth of synthetic threads, fastened by needle piercing, the outer face and reverse layers being of equal thickness and surface density, between them is placed an additional fibrous layer, the density of its piercing being two times higher than of the outer layers, and a temporary framework cloth is placed in the additional fibrous layer at a distance from the outer surfaces of the face layer and the reverse layer, the thickness of it exceeding each of said layers.

The essence of the present method is comprised in that the temporary framework layer is placed in the additional fibrous layer, which is formed between the outer layers having identical thickness and surface density, the needlepiercing being performed from the side of the face layer to a depth, which does not reach the reverse layer, and from the side of the reverse layer to a depth, which does not reach the face layer, and the heat treatment is performed on a friction calender, the correlation of the linear velocities of its inlet and outlet rolls being 1:1,2-1,5.

If the correlation of the linear velocities of the inlet and outlet rolls form a magnitude less than 1:1,2, a shift of the fibres of the face layer does not occur in this case in relation to the reverse layer, and the needle traces received as a result of the piercing will take a perpendicular position to the flow of pollutant particles. A possibility of passing through these openings arises for the pollutant particles, which at high pressure will press heavy on the structure of the material and damage it. In case the correlation between the linear velocities of the rolls of the calender is increased more than 1:1,5, a sharp decrease of the airpermeability of the filter material is observed, which later, at the gas inlet to the filter material, brings about an increase in the pressure, which is high even without that, and a possibility of damaging it.

The drawing shows a schematically illustrated material, in cross-section.

The material consists of outer face 1 and reverse 1 layers, an additional fibre layer 3, in which a temporary framework layer 4 is placed in the form of a woven or a nonwoven cloth, with fibre bundles 5 attaching the layers.

The layers 1-3 are made of synthetic fibres, and the layer 4 of synthetic threads.

Depending on the predominance of a pollutant of a certain type (fine-grained, large-grained, polydispersive) in the gas the material is used with different positioning of the temporary framework layer in the additional fibrous layer.

When using a multi-layered filter material the process of cleaning gases progresses as follows: large pollutant particles (60 micromillimetres and more) are separated on the border of the gas – levelled surface of the face layer. By periodical shaking of the cloth they are removed from its surface and do not comprise an obstacle for the passing trough the face layer 1 of pollutant particles of a size less than 60 micromillimetres. The last mentioned particles stay in the outer face layer and particles of lesser sizes (up to 10 micromillimetres) are delayed by the additional fibrous layer 3. Besides that, as a result of the three-dimensional structure, which is fastened by fibre bundles 5, the mentioned pollutant particles are evenly spread out in the additional fibrous layer. The separation of the smallest pollutant particles (micromillimetres) from the gas takes place on the border of the additional fibrous layer – temporary layer 4. The outlet of the purified gas and the separation of the remaining pollutant particles takes place on the border of the additional fibrous layer – the outer reverse layer 2. A less dense structure of the outer reverse layer does not prevent the passing of the cleaned gas, and the pressure gradient at the inlet and outlet of the filter material is insignificant. This guarantees a stable functioning of the material for a long period (1-3 years).

Example 1. Fibrous layers, which have been formed by means of a mechanical method from 100 % polyester fibre, having a linear density 0,33 tex and cutting length 65-70 mm, are put in the following way: Initially a reverse fibre matting is formed having a surface density of 60 g/m^2, thereon a formed part of an additional fibrous layer is put, comprising 13 g/m^2. On the part of the additional layer a temporary framework layer in the form of a woven made of complex polyester threads and having a linear density of 111 tex x 2 is unrolled. The temporary framework layer is covered with a second part of the additional layer having a surface density of 167 g/m^2, and thereafter with a fibrous face layer, comprising 60 g/m^2. Thereafter they are connected with a temporary layer by the method of needle piercing on a needlepunching machine IM-1800M. The needle piercing is realized in the following way: from the

side of the face layer to a depth (5 mm), which does not reach the reverse layer, and from the side of the reverse layer to a depth (5 mm), which does not reach the face layer. The mentioned size of piercing depth guarantees a good accumulating effect of fibres of the additional layer and their compact joining with the temporary framework layer. As a result of the needle piercing the density of the piercing of the face layer and reverse layer comprises 120 g/m^2, and the density of the piercing of the additional fibrous layer 240 g/m^2.

Thereafter the obtained nonwoven material is subjected to heat treatment on a frictional calender of the type L KO at a temperature of 130 °C, the correlation of the velocities of the inlet and outlet rolls being 1:1,5.

A filter material is obtained, in which the temporary framework cloth is placed in a lower part of the additional fibrous layer at a distance from the outer surfaces of the face layer and the reverse layer, which filter material exceeds the mentioned layers in thickness. The use of such a material is effective, when cleaning gas from fine-grained particles (1-10 micromillimetres).

Example 2. Fibrous layers are made and arranged according to example 1. The temporary framework layer in the form of a nonwoven needle sewn cloth of class 14 made of polyamide threads 29 tex is arranged in the middle of the additional fibrous layer. The fibrous layers are attached with the temporary layer and to each other by the method according to example 1 by the same technical parameters. After that the obtained nonwoven material is subjected to heat treatment on a frictional calender of the type L KO at 130 °C, the correlation of the velocities of the inlet and outlet rolls being 1:1,35.

A filter material is obtained, in which the temporary framework cloth is placed in the middle of the additional fibrous layer.

The use of such a material is effective, when cleaning gases containing polydispersive pollutant particles. The placing of the temporary framework layer in the middle of the fibrous layer guarantees the stability of the size of the pressure gradient for a long period of time.

Example 3. Fibrous layers are made and arranged according to example 1. The temporary framework layer in the form of a nonwoven needle sewn cloth of class 14 made of polyamide threads 29 tex is arranged in the upper part of the cloth at a distance equal to the sum of the thicknesses of the face layer, the surface density of which is 60 g/m^2, and the part of the additional fibrous layer, the surface density of which is 13 g/m^2. The surface density of the lower part of the additional fibrous layer comprises 167 g/m^2, the

surface density of the reverse layer corresponds to that of the face layer and comprises 60 g/m^2. The fibrous layers are attached with the temporary layer and to each other by the method of needle piercing according to example 1. The heat treatment is carried out at the same temperature as in example 1, but the correlation of the velocities of the inlet and outlet rolls being 1:1,2.

A filter material is obtained, in which the temporary framework cloth is placed in the upper part of the additional fibrous layer at a distance from the surface of the face layer equal to the sum of the thicknesses of the face layer, and the part of the additional fibrous layer, at a distance from the surface of the reverse layer equal to the sum of the thicknesses of the reverse layer, and the remaining part of the additional fibrous layer.

The use of such a filter material is effective, when cleaning gases containing large-grained pollutant particles.

The placing of the temporary framework layer in the upper part of the cloth guarantees a high effectivity for cleaning of gas at an insignificant increase of pressure (10-15 %).

The table presents the characteristics of the filter material.

An analysis of the table shows that the durability characteristics of the present filter material are 1,3-1,8 times better with respect to length and 1,5-1,7 times better with respect to width compared with known materials, but the airpermeability of the present filter material is 1,4-3,3 times lower than that of known materials. Such characteristics of the filter material guarantee a more effective cleaning of gas from pollutants.

Claims:

1. Multi-layered filter material for the cleaning of gases, comprising the following layers, attached by needle piercing and heat treatment: an outer face layer and an outer reverse layer made of synthetic fibres, and and a temporary framework layer, which preferably is realized in the form of a woven or nonwoven cloth made of synthetic threads, characterized in that to improve the operating characteristics of the material without increasing its raw material capacity the filter material is equipped with an additional fibrous layer, the density of its needle piercing being two times higher than that of the outer face layer and the outer reverse layer, moreover a framework layer is placed in the additional fibrous layer at a distance from the outer surfaces of the face and reverse layers, which framework layer exceeds them in thickness, moreover the face and reverse layers are realized with an equal thickness and surface den-

sity.

2. Method of making a multi-layered filter material for the cleaning of gases, comprising: forming the material of outer face and reverse fibrous layers, simultaneously placing a temporary framework layer in the form of a woven or a nonwoven cloth made of synthetic threads, attaching the mentioned layers and the framework cloth by means of needle piercing and thereafter by heat treatment, characterized in that to improve the operating characteristics of the material without increasing its raw material capacity, an additional fibrous layer arranged with a framework layer in it, is placed between the outer layers having an equal thickness and surface density, the needle piercing being performed to its border from the reverse layer and the needle piercing from the side of the reverse layer is performed to its border from the face layer, and the heat treatment is performed on a friction calender, the correlation of the linear velocities of its inlet and outlet rolls being 1:(1,2-1,5).